1. How many milliliters of 6.00 M HCl solution would be needed to react exactly with 20.0 g of pure solid NaOH?

\[ \text{HCl(aq) + NaOH(s)} \rightarrow \text{NaCl(aq) + H}_2\text{O(l)} \]

\# moles of NaOH = \# moles of HCl
\# moles of NaOH = \( \frac{m}{MW} \)
\# moles of NaOH = \( \frac{20.0}{(22.99 + 16.00 + 1.008)} = 0.500 \) moles of NaOH
\# moles of HCl = 0.500 moles
\# moles of HCl = \( M \times V \)
\# moles of HCl / \( M = V \)

\[ 0.500 \text{ mol} / 6.00 \text{ molL}^{-1} = V \]

\[ V = 83.3 \times 10^{-3} \text{ L} = 83.3 \text{ mL of HCl solution.} \]

2. How many milliliters of 0.250 M HCl would be needed to react exactly with 10.5 g of solid NaHCO₃?

\[ \text{NaHCO}_3(s) + \text{HCl(aq)} \rightarrow \text{NaCl(aq)} + \text{CO}_2(g) + \text{H}_2\text{O(l)} \]

\# moles of NaHCO₃ = \# moles of HCl
\# moles of NaHCO₃ = \( \frac{m}{MW} \)
\# moles NaHCO₃ = \( \frac{10.5}{(22.99 + 12.01 + 1.008 + 3 \times 16.00)} = 0.125 \) moles of NaHCO₃
\# moles of HCl = 0.125 moles
\# moles of HCl = \( M \times V \)
\# moles of HCl / \( M = V \)

\[ 0.125 \text{ mol} / 0.250 \text{ molL}^{-1} = V \]

\[ V = 50.0 \times 10^{-3} \text{ L} = 50.0 \text{ mL of HCl solution.} \]

3. How many milliliters of 0.115 M Na₂S solution will exactly react with 35.0 mL of 0.150M AgNO₃ solution?

\[ 2\text{AgNO}_3(aq) + \text{Na}_2\text{S(aq)} \rightarrow \text{Ag}_2\text{S(s)} + 2\text{NaNO}_3(aq) \]
# moles of Na₂S = ½(# moles of AgNO₃)

# moles of AgNO₃ = M x V = 0.150 molL⁻¹ x 35.0 x 10⁻³ L = 5.25 x 10⁻³ moles

# moles of Na₂S = 0.5 x 5.25 x 10⁻³ = 2.625 x 10⁻³ moles

# moles of Na₂S = M x V

# moles of Na₂S / M = V

2.625 x10⁻³ mol / 0.115 molL⁻¹ = .0228 L = 22.8 mL

4. How many milliliters of 0.124 M NaOH solution will exactly react with 35.0 mL of 0.210M H₃PO₄ solution?

3NaOH(aq) + H₃PO₄(aq) → Na₃PO₄(aq) + 3H₂O(l)

# moles of NaOH = 3 x # moles of H₃PO₄

# moles of H₃PO₄ = M x V

# moles of H₃PO₄ = 0.210 x 35.0 x10⁻³ = 7.35 x 10⁻³ moles

# moles of NaOH = 3 x 7.35 x 10⁻³ = 2.21 x 10⁻² moles

# moles of NaOH = M x V

# moles of NaOH / M = V

V = 2.21 x 10⁻² mol / 0.124 molL⁻¹ = 0.178 L = 178 mL

5. How many milliliters of 0.124 M NaOH solution will exactly react with 25.0 mL of 0.210 M H₂SO₄ solution?

2NaOH(aq) + H₂SO₄(aq) → Na₂SO₄(aq) + 2H₂O(l)

# moles of NaOH = 2 x # moles of H₂SO₄

# moles of H₂SO₄ = M x V

# moles of H₂SO₄ = 0.210 x 25.0 x10⁻³ = 5.25 x 10⁻³ moles

# moles of NaOH = 2 x 5.25 x 10⁻³ = 1.05 x 10⁻² moles

# moles of NaOH = M x V

# moles of NaOH / M = V

V = 1.05 x 10⁻² mol / 0.124 molL⁻¹ = 0.085 L = 85 mL